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*Capacity Analysis of
By-Pass Storm Sewer*

Bay Street/Old
Venice Road
North Creek,
Sarasota County

Prepared for:
Sarasota County

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and Associates, Inc.

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**CAPACITY ANALYSIS OF BY-PASS STORM SEWER
AT BAY STREET/OLD VENICE ROAD
NORTH CREEK, SARASOTA COUNTY**

Prepared for:

**SARASOTA COUNTY
STORMWATER ENVIRONMENTAL UTILITY
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1.0 PURPOSE AND AUTHORIZATION

The objectives of this study are:

- To compare the hydraulic capacity of the storm drainage conveyance system located at the intersection of Bay Street and Old Venice Road under both pre and post improvement conditions, and
- Quantify the excess discharge, if the post-improvement conveyance capacity is greater than the pre-improvement conveyance capacity, or
- Develop design options for the post-improvement system in order to match the pre-improvement hydraulic conditions, if the post-improvement conveyance capacity is less than the pre-improvement conveyance capacity.

This study was authorized pursuant to Sarasota County Purchase Order No. 505629.

2.0 BACKGROUND

The study area is located in the southern portion of the North Creek drainage basin which ultimately discharges to North Creek via a lateral ditch and lakes 5 and 3 in the Oaks II golf course development.

Approximately 95 acres are contained in the southwest portion of the North Creek drainage basin including the segment of Bay Street from U.S. 41 to Old Venice Road, the westerly half of Old Venice Road from Bay Street to Station 37+00, and the portion of the North Creek drainage basin located southwest of the intersection of Bay Street and Old Venice Road. Under pre-improvement conditions, this area was conveyed to the North Creek lateral via four (4) small culverts under Bay Street. Under post-improvement conditions this entire subbasin has been directed to a stormwater pond located in the southeast portion of Bay Street Park prior to discharging to the North Creek lateral.

The study area contains approximately 242 acres which includes ±55 acres of the Osprey Educational Complex, the east half of Old Venice Road from its intersection with Bay Street to Station 37+00, Bay Street from Old Venice Road to East Pine Ranch Road, Trinity Acres subdivision, and Pine Ranch subdivision. Under pre-improvement conditions this area drained to a 38" x 60" ERCP culvert at the southeast corner of Bay Street and Old Venice Road where it was conducted to the north side of Bay Street and then west via two (2) 48" CMP culverts to the North Creek lateral. The hydraulic characteristics of these three (3) culverts are inventoried below from downstream to upstream:

Culvert No.	Size	Type	Length	U.S. Inv.	D.S. Inv.
1	48"	CMP	45'	10.82	10.05
2	48"	CMP	21'	11.13	10.68
3	38" x 60"	ERCP	35'	10.90	11.26

Under post-improvement conditions, these three culverts were replaced with a continuous storm sewer system. The hydraulic characteristics of the post-improvement storm sewer system are summarized below from downstream to upstream:

Culvert No.	Size	Type	Length	U.S. Inv.	D.S. Inv.
1A	38" x 60"	ERCP	32'	7.91	7.61
1B	38" x 60"	ERCP	400'	5.28	6.00
2	24" x 38"(2)	ERCP	74'	6.98	6.67
3	29" X 45"	ERCP	8'	6.89 ¹	6.98

¹ A weir with an invert elevation of 8.31 NGVD is located at the upstream end of the culvert.

As originally designed, an open inlet with a 3.5' x 4.0' grate was provided at the upstream end of the post-improvement storm sewer system. The top of the grate was constructed at elevation 11.14 NGVD which corresponds to the design invert of the swale along the south side of Bay Street. However, this Bay Street swale was actually constructed approximately 18 inches lower than the design. As such a portion of the east storm sewer stub-out at Bay Street is exposed.

3.0 APPROACH

The entire open drainage systems along the east side of Old Venice Road and the south side of Bay Street were field surveyed to verify invert profiles and existing drainage patterns. SWFWMD one-foot contour aeriels where also reviewed for this purpose.

To the extent possible, design discharges and tailwater elevations documented in previous engineering studies were used for the analysis. Engineering design plans and calculations prepared by Bishop and Associates, Inc. for Bay Street, Old Venice Road, and the Osprey Education Complex were reviewed. The Master Drainage Plan for the Oaks II was also reviewed as it relates to the area of interest. High water marks obtained by Sarasota County for the area were also reviewed.

4.0 ANALYSES

4.1 Design Discharge

Based upon the analyses performed by Bishop and Associates, Inc. in support of the Bay Street, Old Venice Road and Osprey Education Complex projects, the design discharge for the by-pass storm sewer at Bay Street and Old Venice Road is 49 cfs. This design discharge is based upon the 25-year, 24-hour design storm and corresponds to a unit discharge rate of 0.20 cfs/acre for the 242 acre contributing area.

When the discharge rate from remaining portion of the south North Creek subbasin is considered, the total design discharge to North Creek lateral is 66 cfs. The 17 cfs difference corresponds to the maximum discharge released from the Bay Street Park stormwater pond. The normal water level of this pond is 10.0 NGVD while the design high water elevation is 11.98 NGVD, based upon the Bishop and Associates, Inc. analyses.

A review of the master drainage plan for the Oaks II prepared by Post, Buckley, Schuh and Jernigan, Inc. reported an off-site discharge of 137 cfs from the south subbasin of North Creek. This discharge was based upon a total contributing drainage area of 170 acres and 25-year, 6-hour design storm.

The design discharge used for this study was 49 cfs.

4.2 Design Tailwater Elevation

As previously indicated, the southern subbasin of North Creek outfalls to North Creek via lakes 3 and 5 of the Oaks II and a lateral ditch located north of Bay Street and along the east side of Bay Street Park. Based upon the master drainage plan for the Oaks II prepared by Post, Buckley, Schuh and Jernigan, Inc. the normal water level and design high water elevations for both lakes are 7.00 NGVD and 10.50 NGVD, respectively.

The high water mark taken by Sarasota County upstream (south) of MacEwen Drive following the June, 1992 flood was 10.74 NGVD. This high water elevation would correspond to the north end of lake 5 in the Oaks II.

The design tailwater elevation was taken as 11.0 NGVD at the downstream boundary condition of the analyses (southeast corner of Bay Street Park).

4.3 Pre-Improvement Analysis

Inlet/outlet control computations, as applicable were performed to determine the water surface

profile from the southeast portion of Bay Street Park to the southeast corner of Bay Street and Old Venice Road. As previously indicated, a design tailwater elevation of 11.0 NGVD with a design discharge of 49 cfs was utilized. The results for the pre-improvement conditions are summarized below and are presented on FIGURE 2.

Culvert No.	Area (s.f.)	R (ft.)	Ke	TW (NGVD)	HW Inlet (NGVD)	HW outlet (NGVD)
1	12.566	1.000	0.5	11.0	13.86	11.60
2	12.566	1.000	0.5	13.86	14.17	14.30
3	12.900	0.969	0.5	14.30	-	14.68

4.4 Post-Improvement Analysis

Two scenarios were analyzed for the post-improvement conditions. The first scenario represents the design conditions which only considers the upstream inlet at elevation 11.14 NGVD as being available to accommodate the design discharge. The second scenario considered both this inlet and the modified conditions whereby a portion of the east 29" x 45" ERCP stub-out are available to accommodate flows.

4.4.1 Design Conditions

Based upon the design tailwater elevation of 11.0 NGVD, the entire post-improvement storm sewer system would be submerged and therefore under outlet control conditions. Headlosses at the upstream inlet were computed using the orifice equation with an area equal to ½ of the grate size. Utilizing the design discharge of 49 cfs, the results are summarized below and are presented on FIGURE 3.

Reach	Area (acres)	R (ft.)	Ke	TW (NGVD)	HW (NGVD)
Culvert 1A & B	12.90	0.969	0.8	11.0	11.90 ¹
Culvert 2	5.10(2)	0.613	0.7	11.90	12.76 ²
Inlet 3	7.0 ³	N/A	N/A	12.76	14.87 ⁴

¹ T/G of inlet = 11.05 NGVD

² T/G of inlet = 11.14 NGVD

³ Based upon ½ of 3.5' x 4' grate inlet

⁴ Based upon orifice equation

4.4.2 Modified Conditions

The modified conditions were analyzed by equating the headloss equations for the 29" x 45" ERCP culvert (under outlet control conditions) and the inlet grate (orifice equation) with the constraint that the sum of the discharge rates accepted be limited to 49 cfs. The results of this analysis are summarized below and are presented on FIGURE 4.

Reach	Area (acres)	R (ft.)	Ke	TW (NGVD)	HW (NGVD)
Culvert 1A & B	12.90	0.969	0.8	11.0	11.90
Culvert 2	5.10(2)	0.613	0.4	11.9	12.65
Culvert 3	7.4	0.736	0.5	12.65	13.18
Inlet	7.0	n/a	n/a	12.65	13.18

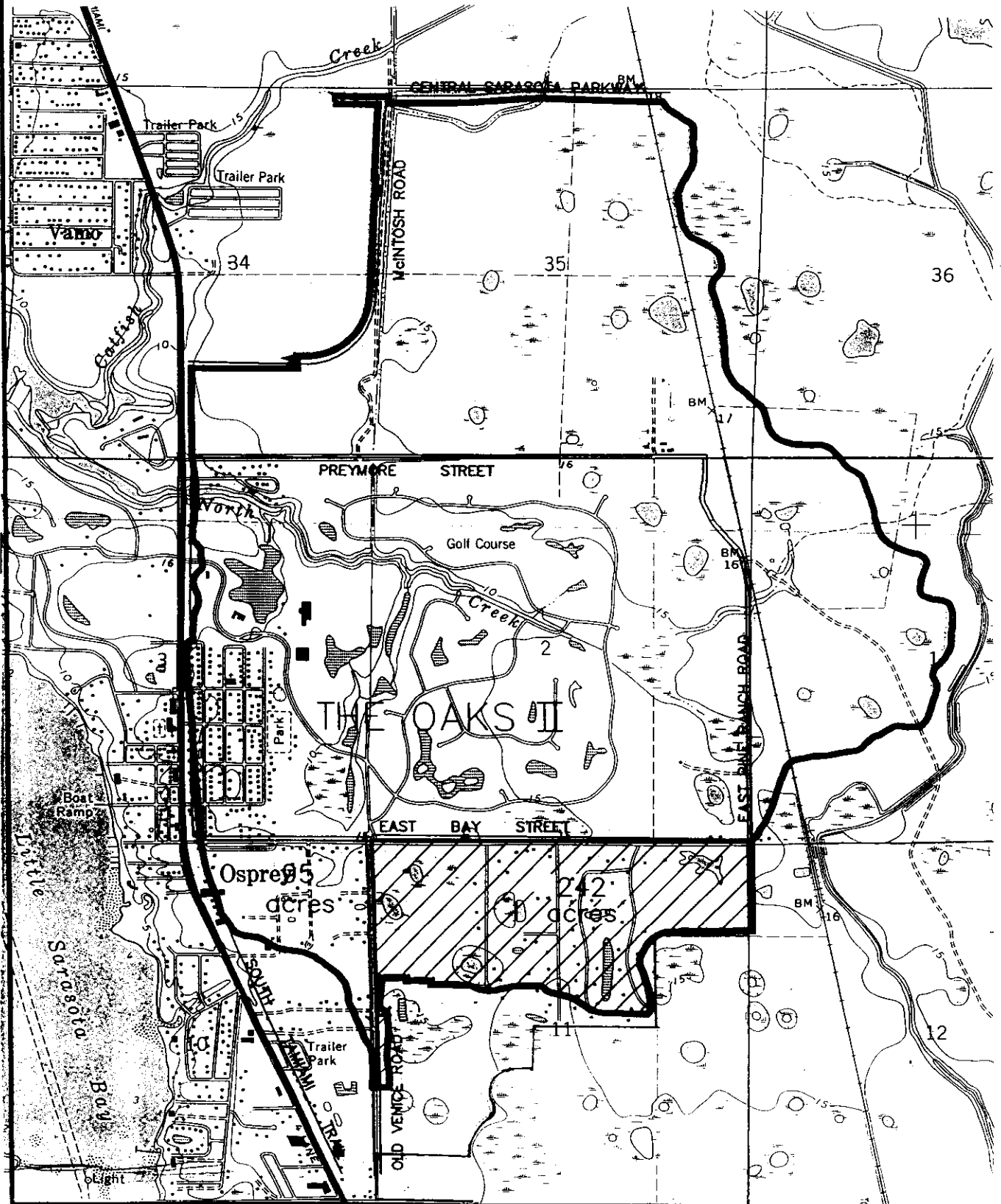
5.0 RESULTS AND CONCLUSIONS

As indicated by the analyses in the previous section, although original design conditions would result in 0.19 ft. increase in the headwater elevation at the southeast corner of Bay Street and Old Venice Road from pre-improvement conditions, the field modified conditions which represent existing conditions, would result in a 1.5 ft. reduction in the headwater elevation.

Since the post-improvement condition is expected to provide greater conveyance capacity than the pre-improvement condition at the point of interest, this increase was quantified in terms of increased flow capacity at the pre-improvement headwater elevation. The results of this analysis are summarized below and indicate that a peak discharge rate of 64 cfs could be accommodated at the pre-improvement headwater elevation of ± 14.7 NGVD.

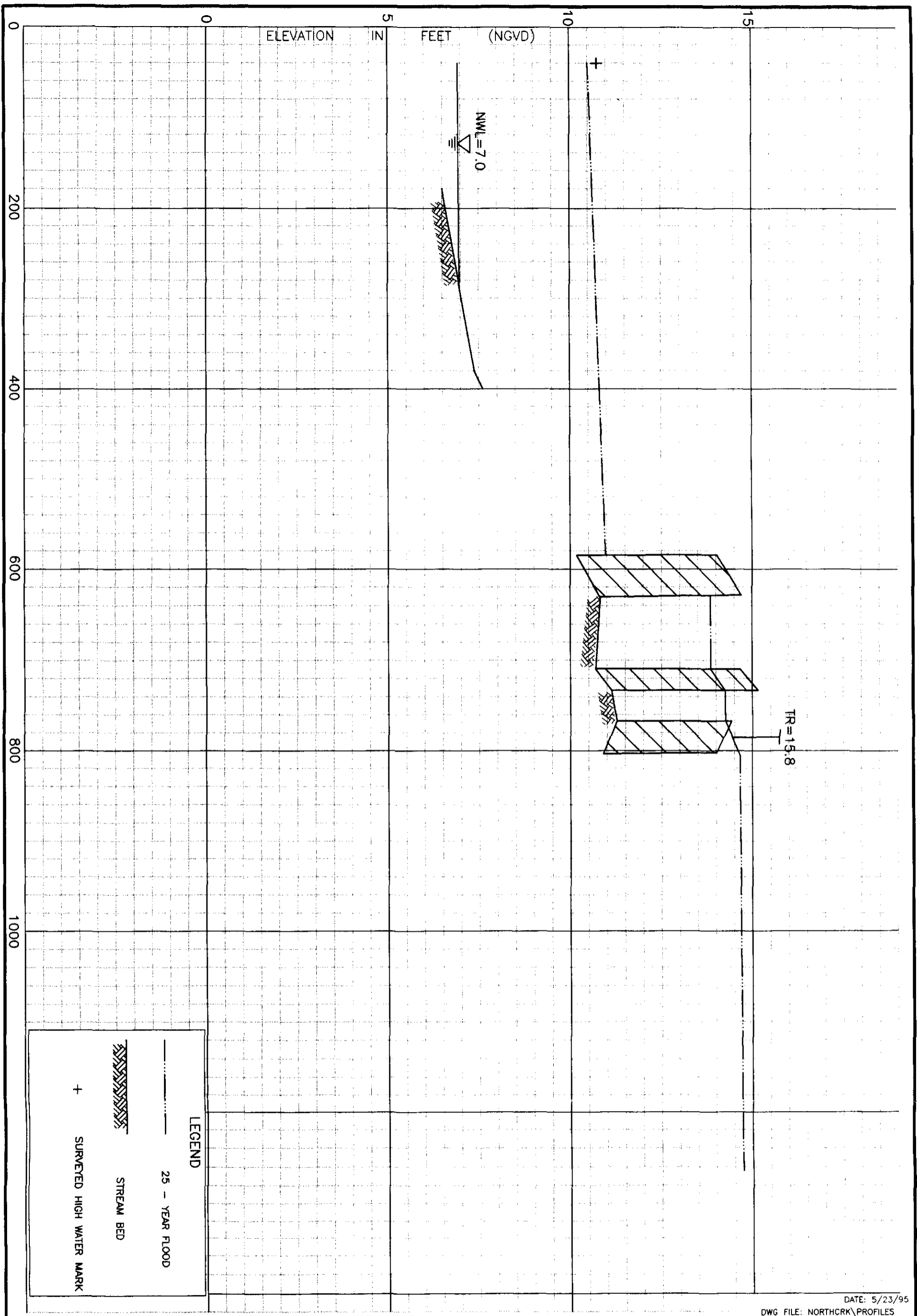
Reach	Area (acres)	R (ft.)	Ke	TW (NGVD)	HW (NGVD)
Culvert 1A & B	12.90	0.969	0.8	11.00	12.53
Culvert 2	5.10(2)	0.613	0.4	12.53	13.81
Culvert 3	7.40	0.736	0.5	13.81	14.70
Inlet	7.00	n/a	n/a	13.81	14.70

MAP OF STUDY AREA



Kimley-Horn
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FIGURE 1



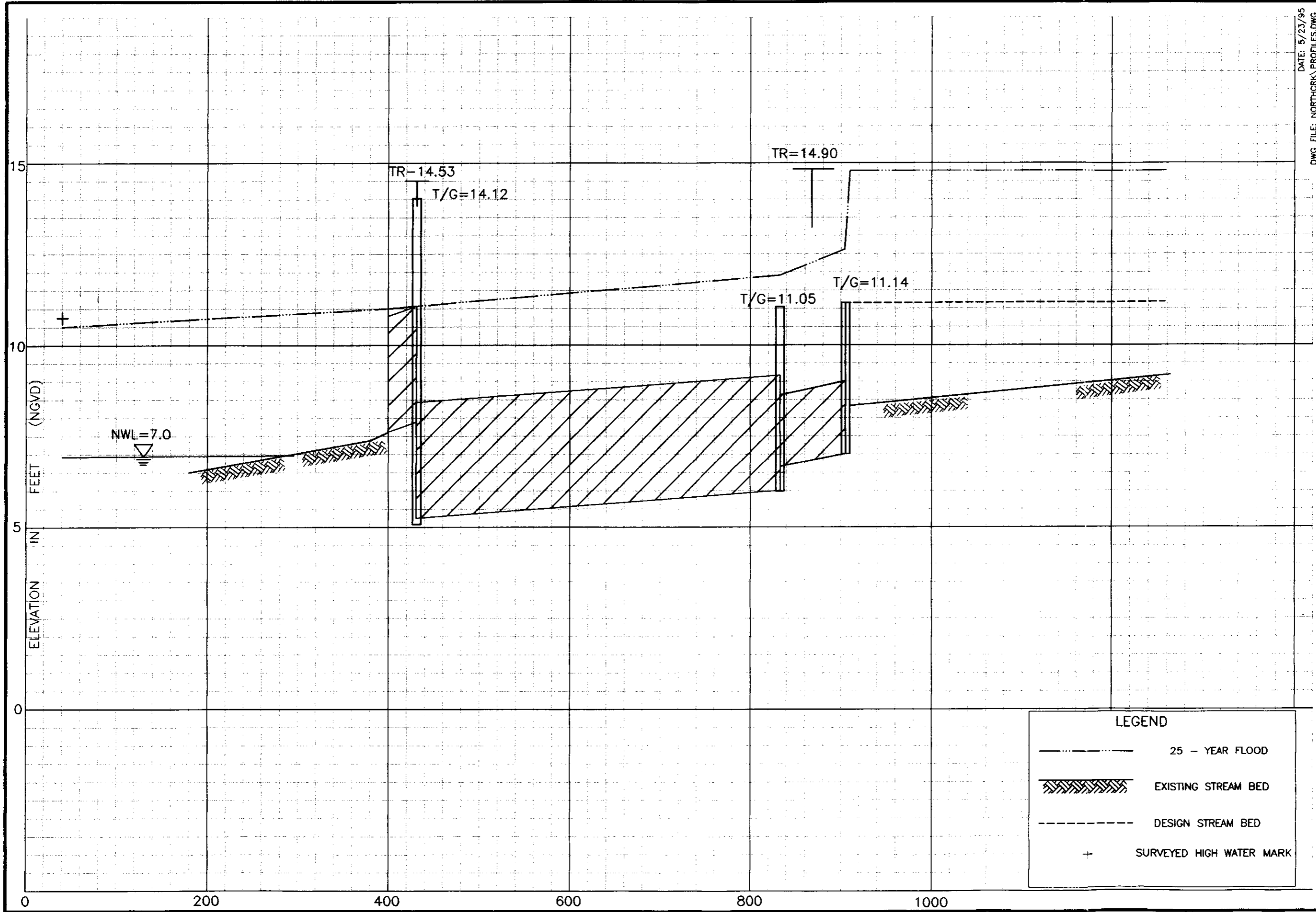
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NORTH CREEK SOUTH LATERAL
 BY-PASS CULVERT @ BAY STREET
 AND OLD VENICE ROAD
 PRE-IMPROVEMENT CONDITION

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FIGURE 2

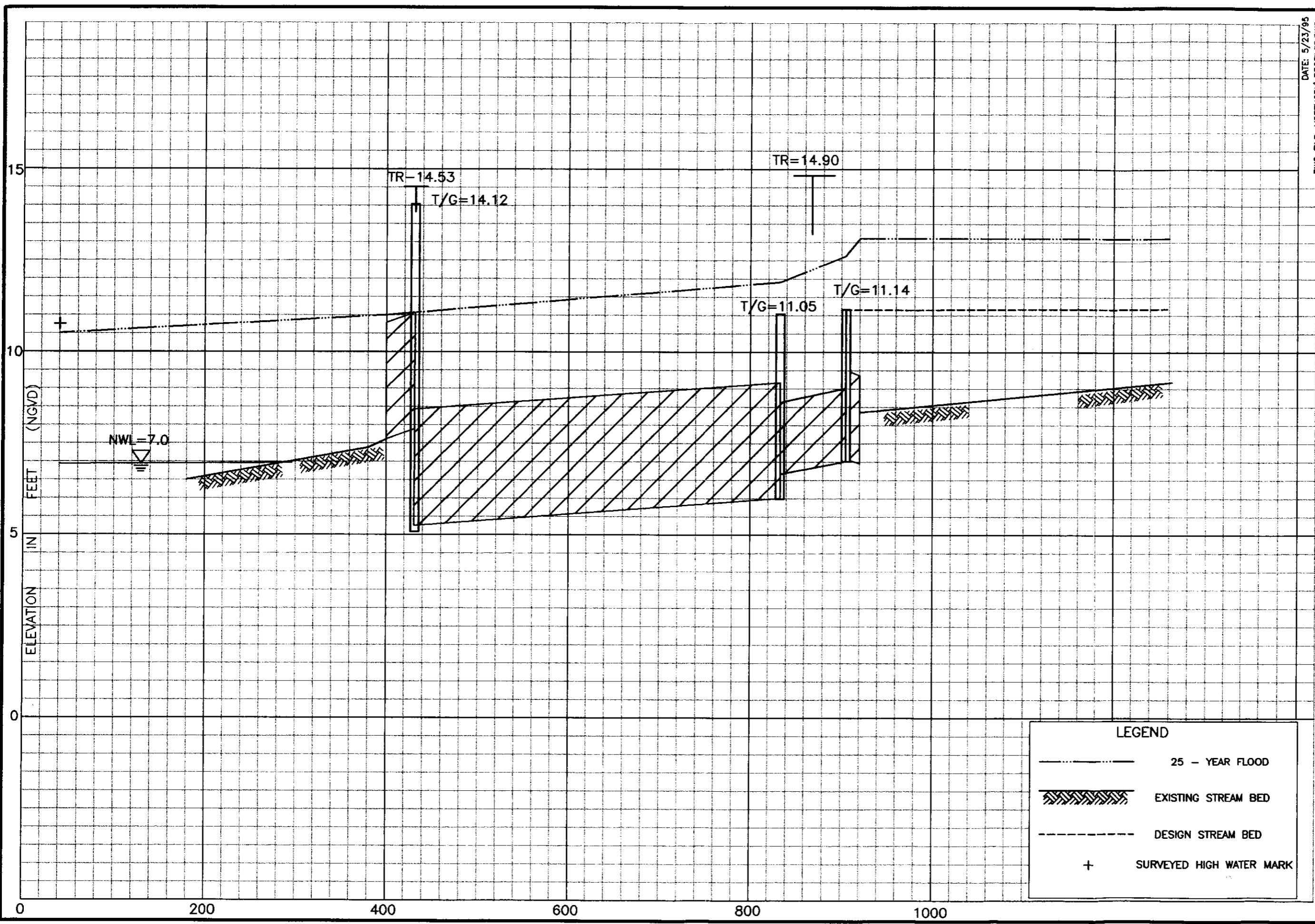


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NORTH CREEK SOUTH LATERAL
BY-PASS CULVERT @ BAY STREET
AND OLD VENICE ROAD
POST-IMPROVEMENT CONDITION

FIGURE 3



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NORTH CREEK SOUTH LATERAL
 BY-PASS CULVERT @ BAY STREET
 AND OLD VENICE ROAD
 POST-IMPROVEMENT MODIFIED CONDITION

FIGURE 4